PERIODICAL ROOM
RECEIVED
APR 1 1916
UNIV. OF MICH.
LIBRARY

Vol. XIII, No. 3 PSYCHOLOGICAL REVIEW PUBLICATIONS March 15, 1916

Psychological Bulletin

EDITED BY

SHEPHERD I. FRANZ, Govt. Hosp. for Insane
HOWARD C. WARREN, Princeton University (*Review*)
JOHN B. WATSON, Johns Hopkins University (*J. of Exp. Psych.*)
JAMES R. ANGELL, University of Chicago (*Monographs*) and
MADISON BENTLEY, University of Illinois (*Index*)

WITH THE CO-OPERATION OF

J. W. BAIRD, Clark University; B. T. BALDWIN, Swarthmore College; E. B. HOLT, Harvard University; W. S. HUNTER, University of Texas; J. H. LEUBA, Bryn Mawr College; MAX MEYER, University of Missouri; R. M. OGDEN, University of Kansas; W. D. SCOTT, Northwestern University; E. E. SOUTHARD, Boston Psychopathic Hospital; F. M. URBAN, University of Pennsylvania; G. M. WHIPPLE, University of Illinois; R. S. WOODWORTH, Columbia University.

CONTENTS

General Reviews and Summaries:

The Last Decade of Psychology in Review: C. A. Ruckmich, 109. *Sensation—General:* M. Bentley, 120. *Vision—General Phenomena:* E. B. Holt, 122. *Vision—Color Defects:* S. P. Hayes, 131. *Taste and Smell:* E. A. McC. Gamble, 134. *Cutaneous and Kinæsthetic Senses:* J. T. Metcalf, 138.

Special Reviews:

Shepard's Circulation and Sleep: E. P. Frost, 142. *Goddard's Criminal Imbecile:* R. H. Gault, 143.

Discussion:

Association and Personality: F. L. Wells, 146.

Books Received, 147; *Notes and News*, 148.

PUBLISHED MONTHLY BY THE

PSYCHOLOGICAL REVIEW COMPANY

NORTH QUEEN ST., LANCASTER, PA.,

AND PRINCETON, N. J.

Agents: G. E. STECHERT & CO., London (2 Star Yard, Carey St., W. C.); Leipzig (Koenigstr., 37); Paris (16, rue de Condé)

Entered as second-class matter January 21, 1904, at the post-office at Lancaster, Pa., under Act of Congress of March 3, 1879

Psychological Review Publications

EDITED BY

HOWARD C. WARREN, PRINCETON UNIVERSITY (*Review*)
JOHN B. WATSON, JOHNS HOPKINS UNIVERSITY (*J. Exp. Psych.*)
JAMES R. ANGELL, UNIVERSITY OF CHICAGO (*Monographs*)
SHEPHERD I. FRANZ, GOVT. HOSP. FOR INSANE (*Bulletin*)
MADISON BENTLEY, UNIVERSITY OF ILLINOIS (*Index*)

WITH THE CO-OPERATION OF
MANY DISTINGUISHED PSYCHOLOGISTS

PSYCHOLOGICAL REVIEW

containing original contributions only, appears bimonthly, January, March, May, July, September, and November, the six numbers comprising a volume of about 480 pages.

PSYCHOLOGICAL BULLETIN

containing critical reviews, notices of books and articles, psychological news and notes, university notices, and announcements, appears monthly, the annual volume comprising about 480 pages. Special issues of the BULLETIN consist of general reviews of recent work in some department of psychology.

JOURNAL OF EXPERIMENTAL PSYCHOLOGY

containing original contributions of an experimental character, appears bimonthly, February, April, June, August, October, and December, the six numbers comprising a volume of about 480 pages.

PSYCHOLOGICAL INDEX

is a compendious bibliography of books, monographs, and articles upon psychological and cognate topics that have appeared during the year. The INDEX is issued annually in May, and may be subscribed for in connection with the periodicals above, or purchased separately.

ANNUAL SUBSCRIPTION RATES

Review and Bulletin, $5 (Canada $5.15, Postal Union, $5.30)
Bulletin, $2.75 (Canada, $2.85, Postal Union, $2.95)
Journal, $3 (Canada, $3.10, Postal Union, $3.20)
Review, Bulletin, Journal and Index, $8.50 (Canada, $8.75, Postal Union, $9)
Review, Bulletin and Journal, $7.75 (Canada, $8, Postal Union, $8.25)
Review, Bulletin and Index, $5.85 (Canada, $6, Postal Union, $6.15)
Current Numbers: Review, 50c; **Bulletin,** 30c; **Journal,** 50c; **Index,** $1.

PSYCHOLOGICAL MONOGRAPHS

consist of longer researches or treatises or collections of laboratory studies which it is important to publish promptly and as units. The price of single numbers varies according to their size. The MONOGRAPHS appear at irregular intervals and are gathered into volumes of about 500 pages with a uniform subscription price of $4.. (Postal Union $4.30.)

Philosophical Monographs: a series of treatises more philosophical in character.

Library of Genetic Science and Philosophy: a series of bound volumes.

Subscriptions, orders, and business communications may be sent direct to the

PSYCHOLOGICAL REVIEW COMPANY

Princeton, New Jersey

FOREIGN AGENTS: G. E. STECHERT & CO., London (2 Star Yard, Cary St., W. C.); LEIPZIG (Koenigstr., 37); PARIS (16, rue de Condé)

Vol. XIII. No. 3. March 15, 1916

THE

PSYCHOLOGICAL BULLETIN

GENERAL REVIEWS AND SUMMARIES

THE LAST DECADE OF PSYCHOLOGY IN REVIEW[1]

BY CHRISTIAN A. RUCKMICH

University of Illinois

Several reasons prompted the author to undertake at this time a literary review of the decade which has just closed. It is exceedingly difficult to refrain from replying in some measure to the charges which in one way or another imply an incompetence on the part of psychology to take its place among the empirical sciences and to make contribution to the fund of knowledge in terms of its own special procedures. The criticisms have come from without and from within the discipline. Philosophers have recently informed us that "the present is a strange and troubled time for psychology"[2] and that the science is compelled "to revise its scale of values, shift its emphasis and direction of progress, and enter into relations of better understanding and coöperation with philosophy, or accept as its portion a distinct subject-matter and move in the direction of increased isolation from human affairs and the remaining body of scientific knowledge."[3] Nor does reproach cease here: from the philosophers we must hear reports of desertions in our own ranks. Says one critic: "To those who have grown suspicious of the definitions and methods commonly employed in

[1] In abbreviated form this paper was read before the American Psychological Association, Chicago, December 28, 1915.

[2] JONES, A. H., "The Method of Psychology," *J. of Phil., Psychol., &c.*, 1915, 12, 462.

[3] BODE, B. H., "The Method of Introspection," *J. of Phil., Psychol., &c.*, 1913, 10, 91.

psychology it is a most hopeful sign that this suspicion has gained active and vigorous support among psychologists themselves."[4] Thus, in the conviction of one of our number, psychology "has failed signally . . . during the fifty-odd years of its existence as an experimental discipline to make its place in the world as an undisputed natural science."[5]

With indictments like these against us, we can fortunately turn with confidence to certain events which must be taken into account when the history of the current decade is written. To anyone who has read with care the reports of the Committee on the Academic Status of Psychology, further reference to this aspect of the subject need hardly be made.[6] In the decade which we are considering, the laboratories of psychology have almost doubled their number. Ten years ago psychology was recognized as a separate department in only four academic institutions; now we have distinct departments in more than thirty-five institutions of this rank. Reports indicate an unusual degree of progress during the year 1915 as regards academic recognition of psychology as an independent science. The following items taken at random from the press suggest more than normal growth:

"The new University of Frankfurt has grouped psychology with the natural sciences in the faculty of science. A recent action by the University of Missouri goes in the same direction. Students who have done no biological work in high school and who therefore have to take in the first or second college year five hours of biological science may fulfill this requirement by taking five hours of psychology. To this extent the University of Missouri recognizes psychology as a biological science." PSYCHOL. BULL., 1915, 12, 243–4; see also p. 127. "The University of Oregon has recently completed a new psychological laboratory." P. 128. "[At Dartmouth] a separate building is to be made available for the departments of psychology and education, and there will be ample quarters for psychological teaching and research."

[4] BODE, B. H., "Psychology and Behavior," *Psychol. Rev.*, 1914, 21, 46.

[5] WATSON, J. B., "Psychology as the Behaviorist Views It," *Psychol. Rev.*, 1913, 20, 163.

[6] Published by the *Amer. Psychol. Assn.*, December, 1914 and 1915. A word ought to be said about one of the conclusions which the author published in an article on the "History and Status of Psychology in the United States," *Amer. J. of Psychol.*, 1912, 23, 517–531. It was stated that "psychology, after twenty-five years of growth, does not stand very high on the honor roll among other academic subjects." The observation does not require withdrawal; it was based upon statistical facts which represented comparative academic recognition in terms of financial support, student registration, and instruction. The first report of the Committee referred to agrees with the statement in several details (see pages 4, 15, 18). The items considered in the article relate only to certain limited phases of growth; a general development of the science is not denied.

P. 243. "The former combined department of philosophy, psychology, and education in the Johns Hopkins University has been divided into three independent departments."[7] P. 243. "George Peabody College for Teachers has received $8,500 . . . for equipping the Jesup Psychology Laboratory. This amount of money is to be spent for furniture, laboratory equipment, and psychological publications." *Science*, 1915, 42, 186. "The department of psychology of Reed College, Portland, Oregon, plans extensive improvements in its laboratory." PSYCHOL. BULL., 1915, 12, 403. "At Vineland, N. J., a new laboratory of 30 rooms is now occupied by the department of psychological research." P. 403.

A further indication of the rank of psychology among the sciences is given by statistics recently tabulated in regard to the number of doctorate degrees conferred in various subjects for the decade. These figures place psychology fifth in order. For the entire decade they are: chemistry 580, physics 242, zoölogy 226, botany 214, psychology 201.[8]

In many of the adverse criticisms, moreover, as has already been indicated in several replies,[9] either an historical background or a sympathetic understanding that comes from a knowledge of the traditional and periodical development of the science is almost, if not entirely, lacking. We need now and then to call a Spencerian halt in our progress and with a self-critical attitude to look back over the path which we have trod with the intention of discovering how far and in what direction we have travelled. It is for this reason that we miss the annual reviews of the general field which have appeared up to the last few years in the BULLETIN; and it is mainly on this account that the present review was undertaken. No complete survey of an extended period is to be found in our literature since the inventory made by Titchener in 1909 at the Clark University celebration. The review covered the preceding decade and succeeded by five years a similar historical summary

[7] About a decade ago the reviewer of the year's work heralded "the installation of the new department of philosophy and psychology with a promising laboratory complement at the Johns Hopkins University" as "turning its face to the future." E. F. BUCHNER, PSYCHOL. BULL., 1905, 2, 98.

[8] Computed from statistics arranged by *Science*, 1915, 42, 557.

[9] "At a time when psychology is taking her place as an independent empirical science among her sister sciences such a treatment [of psychology in its historical development] will, perhaps, help to obviate certain misunderstandings, such as are illustrated in profusion in the attempt of a brilliant contemporary writer to prove that psychology is quite without prospects." O. Klemm, *A History of Psychology* (trans. by Wilm and Pintner), 1914, p. 10. E. B. Titchener remarks: "I call the articles unhistorical because they give no hint that any similar revolt against an established psychology had taken place earlier in psychological history," On "Psychology as the Behaviorist Views It," *Proc. Am. Philos. Soc.*, 1914, 53, p. 4, see also p. 8.

made by the same authority at the St. Louis International Congress.[10] One point which, if we read the history of the times aright, seems to find a parallel across the gap of the decade is to the effect that adverse criticism may often go hand in hand with scientific progress and prosperity. This appears to have been as true in the year of the St. Louis International Congress as it is today. In his summary of the year's literary productivity, Buchner claimed that "this period is chiefly marked by a sudden and widespread reëxamination of the aims, methods, and fundamental conceptions of psychology. It has taken on the form of a social reaction to the earlier teachings of the science."[11] Contrasting with this statement is the one made by Angell in his discussion of the congress: "Taken in their entirety, these papers give the psychologist a flattering sense of the massiveness and dignity of the science which he espouses. So much of solid achievement to stand upon, so wide a territory already laid under contribution—surely these things augur a rapid advance and the speedy realization of those dreams of conquest which fifty years ago seemed the chimerical creatures of overweening ambition."[12] It may be that the two quotations are complementary, that they express two aspects of the situation and indicate that the story is fully told only when adverse criticism is accompanied by a constructive evaluation of actual achievement. To answer the accusations of our critics on purely theoretical grounds would be an endless and thankless undertaking—endless, because beyond each statement quoted lies a whole context of theoretical propositions which have to be met; thankless, because the accuser seldom takes the pains to think himself into the system which he is so laboriously attacking. But we can point to the productivity of the science as an index of its stability and growth, for, to quote a contemporary writer, "that the science is established beyond all peradventure may be gathered from the striking steadiness of its literary output."[13] This paper, then, makes the attempt first of all to answer the question, "*What* has been done in the last decade?"

Our second consideration has to do with method; to the question just put we add another: "*Whereby* has this been done?" In reply

[10] TITCHENER, E. B., "The Past Decade in Experimental Psychology," *Amer. J. of Psychol.*, 1910, **21**, 404–421; "The Problems of Experimental Psychology," 1905, **16**, 208–224.

[11] BUCHNER, E. F., PSYCHOL. BULL., 1905, **2**, 90.

[12] ANGELL, J. R., "Psychology and the St. Louis Congress," *J. of Philos., Psychol., &c.*, 1905, **2**, 546.

[13] BUCHNER, E. F., PSYCHOL. BULL., 1912, **9**, 5.

we have to search for the methods by means of which the work of the decade was accomplished. Naturally most of the critical discussion in which psychology is at present involved centers about the methods of the science: viz., introspection *vs.* behavior. In answer to the query: "Is psychology evaporating?" one psychologist replies: "If psychology is to maintain its place among the sciences, it must not isolate itself from the rest of natural process by limiting its interest to pure introspection or to purely objective behavior";[14] another suggests a "relative paucity of introspective studies";[15] a third views psychology as "a purely objective, experimental branch of natural science which needs introspection as little as do the sciences of chemistry and physics";[16] and a fourth is certain that "there is, as a matter of fact, not the slightest evidence for the reality of 'introspection' as the observation of 'consciousness.' "[17] Again it is not our present business to argue the matter out on theoretical principles; we prefer to let the literary product of the science speak for itself and, incidentally, for the science as well. It has been our purpose, therefore, to discover, if possible, to what extent psychology has relied upon the method of introspection as a means whereby scientific knowledge is sought. These two questions, the *what* and the *whereby* of achievement, stand as the underlying problems of the paper.

The method followed in reviewing the decade is not new; it has been profitably used in the surveys above mentioned. Owing to the complicating factor of the present war, however, only American psychological periodicals were analyzed. The review covers the six general periodicals: the *Amer. J. of Psychol.*, the *Psychol. Rev.*, the PSYCHOL. BULL., the *Psychol. Monog.*, the *Arch. of Psychol.*, and the *J. of Phil., Psychol., &c ;* the psychological numbers of the *California Studies* were also included. Every original theoretical or experimental contribution which appeared from 1905 to 1915 inclusive—a year was added to the decade to bring together the material from the last corresponding review to date—was counted, analyzed, and classified according to the current rubrics of the *Psychol. Index.* The statistical tables upon which our general review rests show, therefore, the number of articles written, the number of pages covered by each article, and the kind of method

[14] MARSHALL, J. R., *J. of Phil., Psychol., &c.*, 1913, 10, 710.

[15] CALKINS, M. W., "The Self in Scientific Psychology," *Amer. J. of Psychol.*, 1915, 26, 524.

[16] WATSON, J. B., *Behavior, an Introduction to Comparative Psychology*, 1914, p. 27.

[17] DUNLAP, K., "The Case Against Introspection," *Psychol. Rev.*, 1912, 19, 412.

which was used in the investigation of which the article is the report. These items are classified under the 75 headings and subheadings found in the *Index*.[18] Over 800 articles covering more than 20,000 pages in the journals were thus analyzed and arranged.

A word in explanation and defense: the author naturally realizes that statistical methods may be abused. Figures require interpretation and interpretation is elastic. Although the results were computed as accurately as possible, care was taken not to emphasize or overestimate comparatively small differences. The same may be said in regard to the classification of methods: to avoid ambiguity it was decided that the introspective method was used whenever an author referred to his results as introspections or whenever he actually quoted introspective analyses. The review of the decade falls, then, into the classification of the *Index* and follows in the order of the headings specified.

I. GENERAL.—In the way of general papers discussing problems, methods, apparatus, technique, and the like, we find a large number of contributions; more papers—about one fourth of the total number of papers for the entire decade—appeared in this field than in any other. The closest competitor is the field of *sensation* and *perception* with the greatest number of pages covered. Arranged in order of number of articles written and in order of the number of pages used, the years 1912, 1905, and 1908 stand at or near the top of both lists, while 1911 and 1915 stand at the other end. This agrees in general with the comments of the reviewer of the years indicated.[19] Naturally the most frequently discussed topic within the group is that of general problems in which the subject of *consciousness* plays an especially prominent rôle in 1905, 1908, and 1913.[20] On this subject three articles, or one fifth of the maximal

[18] In this classification the substance and not the title of the article guided the author in his judgment of its appropriate place, *e. g.*, DODGE, R., "A Working Hypothesis for Inner Psychophysics, *Psychol. Rev.*, 1911, **18**, 167–185, was classified under I.5 (Mind and Body) and not under III.7 (Psychophysics). In several instances the author took issue on these grounds with the classification which the *Index* had given to the articles considered.

[19] We have already noted the comment on the year 1905. Concerning 1912 we read, "The particular interests of the year have been in the nature of critical reactions toward some of the work of former years. These have been most marked in the attacks on introspection as a psychological method, the critical testing of tests, and the more secure establishment of the field of applied psychology." BUCHNER, E. F., PSYCHOL. BULL., 1913, **10**, 3. But this state of affairs is interpreted as "a sign of growth."

[20] The reviewer of the year notes that "the term 'consciousness' seems to face the dangers which years ago routed the term 'soul' and 'mind' from our vocabulary." BUCHNER, E. F., PSYCHOL. BULL., 1912, **9**, 1.

number, with an average length of about eleven pages are accredited to each of the years 1909, 1910, and 1915. Significant for the science is the fact that the next highest number of articles written within the group appear under the heading of *general apparatus and technique*. Some importance must also be attached to the disappearance since 1913 of purely speculative and philosophical articles from the strictly psychological journals.[21] These articles were particularly abundant at the beginning of the decade. The fact that psychological periodicals have not printed more than one purely physiological article in the human field in the decade seems also to point to the conclusion that psychological material has preëmpted the space.

III. SENSATION AND PERCEPTION.—Exceptional activity has been displayed in this field: this is especially true of the years 1908 and 1909. About one fifth of the entire number of papers written fall in this group within which *vision* easily dominates with its complement of one fourth of the total number of papers written in the group. Direct and indirect vision is the most consistently attacked problem. Next in importance is the auditory group in which field sound-localization plays a leading rôle. Remarkable it is that in these eleven years not a single paper on taste and smell has appeared in the general periodicals. The dearth of material on organic sensation complained of by Titchener a decade ago[22] is partially repaired by the publication of five articles in this period: two in 1908 and three in 1915. Over 200 pages in ten articles written for the most part since 1909 is the answer to Titchener's indication of a revival of psychophysics at the close of the previous decade.[23] Work done under the main heading of this paragraph requires unusual patience and application. If a general impression gained by the reviewer be allowed, the investigations carried on in this field have for the most part engaged the attention of specialists in the several branches: persons are carrying on this form of research with a zeal and a persistence less frequently found in other directions. We venture to say that most well-read psychologists can call up more names of investigators connected with the several topics listed under this caption than with any of the others. It is a

[21] The *Psychol. Index* had already given notice in its 1911 number that "philosophical works are noted only if they contain matter of psychological interest."

[22] TITCHENER, E. B., "The Problems of Experimental Psychology," *Amer. J. of Psychol.*, 1905, 16, 211.

[23] *Op. cit.*, 212.

rapidly growing field and one which has become unusually attractive during the last few years.

IV. Feeling and Emotion.—These subjects have made considerable progress since Titchener noted the scarcity of studies in the field a decade ago.[24] One twentieth of the total number of articles written in the decennium are classified under the general rubric; of these more than half were concerned with the affective processes. Many of the studies were made at the beginning of the period, but a gradual increase toward the end indicates a possible crest in a wave of interest just approaching. May we hope for a series of well-planned studies which will supply us with much needed facts in a comparatively neglected field.

V. Motor Phenomena and Volition.—With greater emphasis on the behavioristic tendencies in the psychophysical organism, a relatively large increase in the number of papers concerned with the motor aspects of experience was frankly expected. Curiously, then, *action* is credited with but a little less than one tenth of the total number of pages and papers; what is still more noteworthy is that the highest frequency in the curve is observed at the middle of the decade with a marked decline at the end. The totals in this field equal almost to a digit those which appear under the rubric of *attitudes and intellectual activities*. The year 1909 was the most productive of all and showed interest in both introspective and in non-introspective procedures and in theoretical discussions. The greatest number of studies were concerned with experiments on the reaction and motor consciousness; the problems related to work and fatigue claimed almost as much attention.

VI. Attention, Memory, and Thought.—The total number of contributions closely approximates the corresponding figure under *sensation and perception;* studies of memory compare favorably in number with the work done in *motor phenomena and volition* (*q. v.*). Investigations in the entire field, with the exception of a slight relapse in 1911, have steadily increased in number since the beginning of the decennium. Especially is this true of investigations of the memorial consciousness. In 1915 an unusual amount of interest was also aroused in problems connected with the recognitive consciousness and with the imaginative functions. The studies of attention, however, hardly come up to the expectations aroused at the beginning of the decade. Thirteen papers, or approximately one tenth of the total of the group, are concerned with thought, and a somewhat greater number of papers and pages deal with the exami-

[24] *Op. cit.*, 213.

nation of judgment, belief, and reasoning. *Comparison, abstraction, ideation*, the *psychology of testimony*, the *diagnosis of mental situation, disorders of attention, memory, and thought* stand at the bottom of the list under this rubric with very few or no contributions during the decade.[25]

VII. Attitudes and Intellectual Activities.—Reference has already been made to the rubric. About one third of the total number of articles in the group are concerned with the psychology of language and most of the work was done in 1914. The psychology of religion was extensively discussed at the beginning of the decade, but during the latter half, probably due to increased outlet in the special journals established during the period, not a single article has appeared. Naturally the same may be said in general about educational and animal psychology.

VIII–XII. In the discussion of special mental conditions like sleeping, dreaming, and the study of the effects of ether and other drugs on consciousness, the year 1910 showed the greatest activity. All told, however, these papers number only about one twentieth of the grand total. Nervous and mental disorders and animal psychology receive even less attention in the general periodicals, while the psychology of individual, racial, and social phenomena, and of genetic development were slightly more productive. For reasons just mentioned a considerable decline is also indicated in these fields for the last few years. Consequently a complete review ought not to pass over the fact that several special journals which were founded during the decade, or near its beginning, offer additional avenues for the escape of scientific thought in their specialized fields. The *Journal of Educational Psychology*, started in 1910 and devoting about 400 pages annually to original contribution, and the *Journal of Animal Behavior* together with the *Monograph Series* furnishing yearly since 1911 approximately 550 pages of material in their separate fields, are typical examples; other similar publications include the *Journal of Religious Psychology*, the *Psychological Clinic*, and the *Journal of Abnormal Psychology*.[26] In addition to the

[25] The aberrations of conscious phenomena as a class do not seem to have aroused the interest of the investigators who publish their contributions in the general periodicals. In addition to the topics mentioned, the *disorders of sensation and perception*, the *disorders of feeling*, and the *disorders of movement and instinct* have been, as far as publication in our journals of psychology is concerned, absolutely barren fields during the decade.

[26] By agreement most of the psychological periodicals now publish a complete list of all these journals, together with the general facts concerning their publication and subscription, on the last page of the last cover.

periodicals just mentioned we must not forget that some of the more important general journals are virtually products of the decade. A list of these should include the *Psychological Bulletin* (1904), the *Journal of Philosophy, Psychology, and Scientific Methods* (1904), and the *Archives of Psychology* (1906); special series not yet mentioned are the *Journal of Race Development* (1910) and the *Psychoanalytic Review* (1913).[27] Here surely is evidence of a healthy growth of periodical publication in this country; there is promise of continued increase in the announced—probably, at the time of the publication of this review, the accomplished—appearance of the new *Journal of Experimental Psychology*.

Before summarising the facts so far reviewed, we now turn to that phase of our work which attempts to answer the query: "*Whereby* has all this been done?" Here we have to do with method. All of the articles which appeared in the decade were grouped into four classes: introspective-experimental, introspective-*non*experimental, *non*introspective-experimental, and *non*introspective-*non*experimental. The first two classes contained articles in which the introspective approach was mainly emphasized, *i. e.*, introspections were taken in the investigation, referred to in the results, or specified in the procedure; the first class differs from the second in that the former involved and the latter lacked experimental control of conditions. The third class of articles depended for their results principally upon *non*introspective procedure and material, *i. e.*, they contained records of work done for the most part by means of methods which have come to be designated as behavioristic. The fourth group comprised theoretical, speculative, and general articles. Naturally in limiting cases there was some difficulty in differentiating the groups as given, but practically most of the papers fell easily into one or another category: doubtful cases were credited with half value in each of the two classes to which they doubtfully belonged. Measured in terms of frequency of use, the outcome of the analysis readily established the importance of introspective methods in the way of experimental contribution as compared with the "behavioristic" procedures. Of course in certain special fields, as one rightly would expect, *non*introspective work of an experimental type predominates; but even in some of these, the balance is not decisive. Motor phenomena and volition; the special mental conditions brought about by sleep, drugs, and suggestion; nervous and mental disorders; individual, racial, and

[27] Many of these journals show by count that the pages devoted to original contribution have slightly increased in number from year to year.

social phenomena; mental development in man, including educational psychology; organic evolution, including animal psychology: all of these were investigated with comparatively little reference to introspective procedures. They naturally do not lend themselves to such treatment. The first two topics, moreover, do not give definite returns in our calculation: reckoned in terms of pages covered, introspection shows more frequent use than *non*introspective experimentation. In almost all of the topics discussed there is, of course, much theoretical writing: the subjects treated under the first general heading are almost entirely of this character.

In order, therefore, to make what was considered a fair comparison of the various approaches to the subject of psychology, we drew up a table of ratios calculated approximately from the computed totals as found in connection with those sections which seemed to comprise the main business of general experimental psychology. The sections so selected include headings three to eight, viz., the subjects: sensation and perception, feeling, emotion, volition and motor phenomena, attention, memory, thought, the attitudes and intellectual activities, and special mental phenomena. This, in our mind, delimits the scope of normal, human, adult psychology. In this general field, then, we find that in point of number the introspective studies head the list of investigations in the decade with 234 separate articles; theoretical studies follow with 150; and the *non*introspective experimental papers foot the list with 93. In other words, there are roughly two and a half times as many introspective as nonintrospective experimental papers. The ratios run through the years as follows:

RATIOS SHOWING FREQUENCY OF USE
(Behavioristic methods = 1)

In Terms of Number of Articles			Year	In Terms of Number of Pages		
Experimental-Introspective	Nonexperimental-Introspective	Speculative-Theoretical		Experimental-Introspective	Nonexperimental-Introspective	Speculative-Theoretical
1.3	.3	.77	1905	2.1	.25	1.2
1.5	.55	2.	1906	1.	.26	.6
2.	.9	2.5	1907	2.25	.4	1.08
3.75	.5	5.	1908	12.	.45	3.6
3.	.55	3.7	1909	5.1	.3	1.6
2.5	.37	1.9	1910	6.	.09	2.8
2.3	.37	1.	1911	3.	.25	.8
2.25	..	.8	1912	3.	..	.4
3.	.25	1.1	1913	2.8	.02	.9
1.15	.07	1.25	1914	2.15	.05	.9
2.05	.16	.8	1915	7.	.05	1.16
2.25	.36	1.9	Averages	4.21	.19	1.3

These figures indicate in general a gradual rise in the use of the introspective procedures from the beginning of the decade, with a slump in 1914 and a definite recovery from the critical attacks in 1913–1914 under which introspection apparently suffered.

In conclusion and in answer to our original question, "*What* has been done in psychology during the last decade?" we can point to the work outlined and accomplished in the way of contributions to our general periodicals in the field of sensation and perception, to the progress in the investigation of feeling, and to the increased activity, especially in the last few years, in the study of memory and of recognition. Surely, too, there is in general an increasing productivity in the field of journal publication. Other events of the times, the increase in laboratory facilities, the position which psychology has taken academically among the other sciences, and the gradual emancipation from its parent disciplines, we have mentioned in our opening paragraphs. With all this positive statement, it would not be fair to avoid reference to the decline of researches concerned with the thought consciousness and with the attentive consciousness; it is not unlikely that snags have been struck which must be removed before the initial task may be completed. In the meantime we are getting the benefit of these lateral borings.

The net result of our inquiry into methods employed in the decade in answer to the question, "*Whereby* has all this work been done?" is clear and definite. In terms of the sanction of methods through extensiveness of usage, our study reveals the fact that introspection has contributed more generously to normal, human, adult psychology during the past decade than has any other method. In both phases of our problem, it is extremely difficult, if not impossible, to find a single decadent tendency.

SENSATION—GENERAL

BY MADISON BENTLEY

University of Illinois

In reply to criticisms of Rahn,[1] Titchener (4) dwells upon the distinction to be drawn between "the sensation of classification and the sensation of observation." Under immediate observation some attribute or attributes will be focal, others, as a rule, marginal. Rarely are all the attributes observable at one and the same time. The sensation of classification, on the other hand, includes all the

[1] See BULLETIN, 1915, 12, 100.

attributes which appear at various times and under various determinations but with unchanged excitation; it is the "logical resultant of many observations." This author further defines the sensation of observation by distinguishing it from awareness and other forms of meaning, and also from genetic derivations of consciousness. If sensation is to be regarded existentially and if its problems are to be set apart from the problems of perception, then it is important that the ancient confusion of sensation with perception and of stimulus with object of perception—a confusion discoverable in Titchener and in many other current writers—should be cleared up. In his discussion of the stroboscopic integration of movement, Linke (1) warns his critics—though not effectively—against this confusion. In its crudest form, the confusion appears in Russell's article upon "Sensation and Imagination" (3). Russell's "sensation" is the traditional British "sense," akin to "perception" of current analytical psychology. A propos of the identification of sensation with awareness, it appears to be this logical substitute for the systematic sensation that Herrick (2) means when he argues, upon neurological grounds, against the existence of "static elements." He thinks it unlikely that "simple sensations" exist, because the cortex is exposed in its functions to subcortical entanglements. "The essentials of cortical process seem to consist, not in putting raw sense data into relation with each other, but in integrating complex physiological functions which are already under way and directing them by inhibition, reinforcement, or otherwise in the light of the previous experience of the individual." It may be questioned whether neurological theory can profitably be used at present to discredit observation. The distinction between stimulus and determination might conceivably have enabled Herrick to retain his doctrine of cortical functions without rejecting the results of psychological research.

References

1. Linke, P. Das paradoxe Bewegungsphänomen und die "neue" Wahrnehmungslehre. *Arch. f. d. ges. Psychol.*, 1915, **33**, 261–265.
2. Herrick, C. J. Introspection as a biological method. *J. of Phil., Psychol., &c.*, 1915, **12**, 543–551.
3. Russell, B. Sensation and Imagination. *Monist*, 1915, **25**, 28–44.
4. Titchener, E. B. Sensation and System. *Amer. J. of Psychol.*, 1915, **26**, 258–267.

VISION—GENERAL PHENOMENA

BY EDWIN B. HOLT

Harvard University

Ewald Hering's familiar contention that in the Purkinje phenomenon, the colors blue and green grow relatively brighter by only as much as they become whiter, and that the phenomenon is wholly due to increased dark-adaptation is in complete agreement with the duplex theory of vision so far as extra foveal parts of the retina are concerned. Now in the *Festschrift für H. Sattler* (15) Hering emphasizes once more his further contention that the rod-free fovea is also appreciably dark-adaptable and exhibits the Purkinje phenomenon (although not so strongly as do extra-foveal portions), by describing a not too complicated apparatus for demonstrating this phenomenon in foveal vision. With a small circle of which half is red and half blue, the Purkinje phenomenon can be produced so strongly that "for a few seconds" the blue half almost extinguishes the red by "simultaneous contrast." The phenomenon is transitory because the fovea loses its dark-adaptation more rapidly than other parts of the retina: this transitoriness is comparable to the rapid fading of the *Aderfigur*, etc. If this on the fovea is the same Purkinje phenomenon that is ordinarily gotten on the peripheral retina, the fact would not seem to be immediately in harmony with the duplex theory. It would be interesting to know whether the red used in Hering's observation can be replaced by orange and yellow. Hering describes a very simple means of showing that unless the eye is dark-adapted the P. phenomenon can not be gotten even in peripheral vision. Schaefer (22) points out that according to the duplex theory, a white spot foveally viewed but too feebly illuminated to stimulate the cones would not be seen as black, but would be seen not at all; in other words, the fovea in twilight vision would figure as does the blind-spot in daylight vision. Just this his experiments show to be the fact. Furthermore, if in twilight vision the field immediately surrounding the fovea is uniformly (but of course feebly) stimulated, the foveal gap appears like the rest of the field; *i. e.*, it is "filled in" as is the blind-spot in daylight vision.

Blachowski (4) has continued his work on *Binnenkontrast*, this time with the *dark-adapted* eye. A momentarily illuminated disc (on fovea or periphery) is seen to light up from its edge towards its

center, and to fade away in the same direction. The disc appears to have at its center a dark region, which is sometimes surrounded by one or more dark rings. This dark central portion becomes larger if the whole disc is made larger, but becomes smaller and less distinct as the brief illumination of the disc is lengthened, or as the intensity of illumination is increased. The author argues that in dark-adaptation (as he has previously shown for light-adaptation) adjacent retinal elements (whether rods or cones) show a mutual inhibition of stimulation (*Binnenkontrast*). Certain phenomena, under dark-adaptation, seem to show that prior to the inhibition a mutual summation takes place, as found by Exner (*Bahnung*) and for rod-vision by Piper; and for threshold stimuli the author admits that perhaps summation is the only *perceptible* phenomenon. The argument is acute but perhaps less convincing than in the author's previous paper on *Binnenkontrast* under light-adaptation; it is helped out by recourse to "very complicated" central factors (attention, etc.). Lohmann (**19**) finds binocular summation of threshold stimuli if he works from above the threshold downwards, but not if he starts below the threshold and works up. He proposes a distinction between summation of stimuli and summation of sensations.

Miles (**20**) studies after-images as projected on backgrounds of different intensities, and with intermittent exposure of such backgrounds. A faded after-image can be "revived by stimulation of neighboring areas, in the absence of direct stimulation of the initially excited retinal areas. This indicates the possibility of a 'spread' of impulses from the rest of the retina and in particular from those paths bordering those originally stimulated." Under some circumstances (fatigue ?) the paths previously excited by a stimulus seem to be blocked to the passage of subsequent impulses. "The blocking effect seems to be confined to the actual paths that have been previously opened through the synapses. Such a block or increase of resistance would be produced by a retraction of the cell processes and, though it is improbable that this movement will ever be seen actually taking place, there is abundant indirect evidence in support of the possibility of such action." This theory is argued for at length. "The recurrent image, which appears on momentary stimulation of the retina, appears to be due to the intermittent passage of impulses through the synapses such as might be brought about by rhythmical approximation of [cell] processes under the influence of continued retinal activity." The

observed reduction of intensity on prolonged fixation of a light is attributed to retraction of cell processes. Positive and negative after-images are accounted for, respectively, by openness of the image path with high resistance of the surrounding tracts and vice versa. The colors of projected after-images are studied, but (as always heretofore) the results cannot be simply formulated.

In regard to color-theory Dunlap (**7**) points out (what is often lost sight of) that Helmholtz's choice of red, green, and blue for primary colors was hardly more than accidental. Dunlap conceives that "the acceptance of green and red as primaries prevents a realistic interpretation of the phenomena of color vision, since a really *red* object is (probably) seen as *yellow* by the dichromopsic individual, whereas red is not compounded from yellow, but yellow from red, according to the theory." Dunlap proposes, as primaries, yellow, peacock and mauve. One wonders how far realism is in question, here, for the author adds, "So far as we can assume psychologically, some person or animal might see as blue, or as any other color, or even as the note $b^{\flat}$, the object I see as red." Edridge-Green (**9**) gives observations from which he concludes "that there is no evidence supporting the view of the composite character of the yellow sensation when produced by pure yellow spectral light."

Day (**5**) has worked on the action currents of the eyes *in situ* of live pike, by means of the Einthoven galvanometer and with white light. The four variations observed by Piper are confirmed; these are, when the illumination is turned *on*, (*A*) a preliminary negative deflection (latent period of .032 sec.), (*B*) a positive deflection (latent period of .075 sec.), (*C*) in thoroughly dark-adapted eyes a second and much slower positive deflection; and when the illumination is turned *off*, (*D*) a positive deflection (latent period of .049 sec.). From similar experiments Einthoven and Jolly, and Piper inferred the presence of three "visual substances." The author argues that Einthoven and Jolly's substances I, II, and III correspond to Piper's substances II, I, and III respectively.

Zipkin (**26**) continues the work of Gildemeister and Rutenburg[1] on the effect of light interruptions,—for areas larger than the fovea. The results of Gildemeister and Rutenburg are confirmed. After about two minutes of darkness the fovea comes to a constant state of adaptation relative to the perception of light-pauses; the periphery continues for 10 or 15 minutes to increase in sensitiveness to light-pauses (as it increases for constant light). This is not true, however,

[1] Cf. PSYCHOL. BULL., 1915, p. 105.

if the light (interrupted or constant) is red. The length of the threshold pause decreases as the light-intensity increases. But the product (intensity × duration of threshold pause), *i. e.*, the threshold light-subtraction, increases as the light-intensity increases. There seems to be no summation effect for light-pauses which succeed one another at intervals of .7 sec. or at longer intervals. Dunlap (8) finds that the determination of the shortest perceptible time-interval between two flashes of light is made almost impossible by the fact that the first flash is often seen as two successive flashes.[1] This doubleness is less noticeable with light- than with dark-adaptation. The threshold light-interruption appears to increase with increased duration of the first flash. For certain light-adaptations, at least, the threshold for light-pause is lower in the light-adapted than in the dark-adapted eye: this *seems* to disagree with the findings of Gildemeister, Rutenberg, and Zipkin.

Hunter (16) believes that the *retinal* factor (as distinguished from eye-muscle, associative, etc., factors) which helps to give the illusory after-image of motion, is "a *streaming phenomenon* which moves through external space in a direction opposite to that [previously] taken by the stimulus." This streaming phenomenon "may be lymph currents, as Ferree supposes," or it "may be an electrical phenomenon." It is apparently identical with that described by the late A. H. Pierce as "a thin cloud of fine white dust moving across the field of vision" in a direction opposite to the previously watched objective motion. (Baley (2) should note that Pierce was many years before "Rollet" in describing this phenomenon.) Hunter is disposed to reject wholly the "fading after-image" theory for after-illusions of motion; but it does not appear certain, from the text, that he would exclude this factor in connection with the apparent motion of Purkinje's "ghost" and kindred phenomena, which are in a rather different class from those that he is considering.

Gates (13) tries to ascertain whether the difference limens for visual quality (whiteness-blackness) and for visual intensity are alike or different. The two instructions yield significantly different D L's but the "intensity" judgments seem to be "judgments of insistence or *Eindringlichkeit* and not of intensity proper." "We think it possible that some of the extant determinations of the D L for 'brightness' are measures of this insistence rather than of intensity or quality. Whether it is possible by more rigorous instruction,

[1] Cf. Miles, 20, II, p. 108.

inducing a conscious abstraction from other attributes, to secure a true intensive D L of light sensation remains an open question." Smith (23) enquires whether there are "certain color-qualities which make a special appeal to attention." He finds "no predisposition for any one hue, common to all observers"; but believes that further experiments might yield a more satisfactory answer. Baley (2) describes several interesting color changes obtaining by half-closing the eyelids." Many familiar optical illusions (such as Fechner's colors, Pierce's dust-drift, Preyer's pattern) can be intensified in this way. "Half-closing the eyelids" is a procedure that seems little susceptible of any exact control. "McDougall has described the effects of novelty and *intensity*," writes Hartridge (14), "in the processes of antagonism and also the effects of the preponderance of contours on the attention process. To these effects will be given the name 'interest' in this paper." Then (five lines below) he proceeds "to show that 'interest' is able largely to *supersede intensity* as a factor in binocular antagonism, place," etc. (three words italicized by the reviewer). The entire article provokes this same kind of "interest."

Ferree and Rand (11) compare the flicker method and the direct comparison method, for getting heterochromatic brightness equations, to the advantage of the latter method. They believe the flicker method to be unreliable because the stimulations from different wave-lengths rise to their maxima (for any intensity used) at very different rates; so that during the brief flicker exposures the more rapidly rising colors have an undue advantage over those for which the sensation rises more slowly (an effect that is somewhat comparable to the Purkinje phenomenon). The summation due to the rapid repetition of the colored stimulus only partly corrects this error. The tables presented seem to rule out the possible counter-argument that although the *sensation* for some colors arises more slowly, yet the effective *stimulation* may still be secured by one color as quickly as by another; and yet possibly this point would bear further consideration. At the present time, too, there is uncertainty as to how far, in this matter of lag, the color and brightness components of a sensation behave identically (cf. p. 123, note); color-fusion, for instance, results at slower frequencies than brightness-fusion. And if brightness were found to be always one and the same physiological process, with whatsoever color combined, the objection to the flicker method for equating brightnesses would probably disappear. But this has not so far been found. The

point is well taken by Ferree and Rand, that according to the Talbot-Plateau law the colors compared under the flicker method *cannot* reach that full intensity for which the equation (established by the comparision) is going to be asserted as holding. The flicker method, they find, yields an underestimation of the brightness of red and yellow, and an overestimation for blue and green. Although this method is more sensitive, it is true, it is less reliable than the "equality of brightness" method (direct heterochromatic comparison). The circumstance that the flicker method cannot be applied to photographic photometry unless the ratio of open to closed sectors, etc., are exactly adjusted in accordance with rather complicated mathematical formulas, as has been demonstrated by Weber (**25**), strongly confirms the opinion of Ferree and Rand.

Bender (**3**), on the other hand, calls the direct heterochromatic judgments of brightness "*sehr unsicher*." The flicker and the Langley visual acuity methods are found to give "identical" results save that the flicker method is far more sensitive ("*genau*"), and yields smoother curves. Bender finds flicker equations to be practically constant from day to day, and except for violet light (where the fluorescence of the eye interferes) almost equally accurate for all pairs of colors. It is only fair to state that this is the work of a physicist; and that physicists very often ride over the subtler points of physiology and psychology with a naïveté that is only to be matched by the way in which, all too often, the psychologist essays to use the finer instruments of the physicist. In the opinion of the reviewer, Bender's findings by no means overthrow those of Ferree and Rand just cited. In a paper (**17**) that was not accessible to the reviewer Ives and Brady describe a new "flicker photometer for laboratory colored light photometry." The design is highly praised in several places.

In questions of illumination Ferree (**10**) finds that there are three respects in which the efficiency of the eye needs to be tested: (1) brightness discrimination, (2) color discrimination, (3) visual acuity. Threshold judgments are recommended for 1 and 2. For 3, test figures are recommended which are simple (Snellen's series contain so many characters that a variable error of fatigue is introduced) and which test vision rather than apperception (which enters in too largely where ordinary letters and numerals are used). No visual acuity test-card if merely momentarily exposed, will give a reliable measure of the state of efficiency of the eye, since even when tired the accommodation mechanism can rise, in response to a momentary

demand, to practically its normal state. The safer way is to let the acuity-card be fixated for, say, three minutes, during which it will be seen with fluctuating distinctness. The ratio of the total time during which it is clearly seen to the total time during which it is unclearly seen, is a good test of the actual state of acuity. Loss of efficiency, under poor illumination, is very largely due to fatigue in the muscular control of the refraction mechanism. Where direct illuminating systems are used, the brilliant light sources (incandescent-lamp bulbs, etc.) seen on the periphery of the retina tend to draw the fixation away from the far less brilliant objects on which the attention is centered, and towards themselves; and they tend similarly to make the eyes accommodate for the distance at which they are away, and this is often very different from that of the object attended to. As a result, spastic contractions of the accommodation muscles are set up which are both disagreeable and very fatiguing; the fixation muscles also are fatigued. There seem to be three main sources of visual discomfort: (1) the "blinding" sensation caused by a sudden increase in brightness of the object looked at; (2) the sensation of "sand" on the conjunctiva, which can become stinging and painful; (3) pain in the eyeball (and even in the forehead and temples), probably due to fatigue of the accommodation muscles. In (**12**) Ferree and Rand print a résumé of results obtained on the problem of lighting. "In some of the respects most important to the eye, this [the indirect] and the semi-indirect systems with a small direct component of light give the best approximation of the distribution effects characteristic of daylight of any that have yet been devised." But the component of direct light is apt to be made too large. Fatigue due to injudicious lighting is "muscular and not retinal." Generally too much light is provided, yet "when the proper [uniform] distribution effects are obtained, intensities high enough to give the maximum discrimination of detail may be employed without causing appreciable damage or discomfort to the eye." Eye-shades are not a good substitute for lamp-shades, but if the eye-shade is to be used it should be opaque with a light-colored lining. "The observation of motion pictures for two or more hours causes the eye to lose heavily in efficiency," yet little if at all more than it loses "by an equal period of working under much of the artificial lighting now in use." Loss of visual efficiency is rather closely correlated with visual discomfort. Paterson (**21**) believes that when sewing and other work is to be done on fabrics of a uniform color, where one must depend

"for the discrimination of the detailed strands of the fabric on the small shadows cast by one strand on to the next and on the varying brightness over the curved surfaces of each individual strand," then "there is nothing so good as a unidirectional light giving harsh shadows for the discrimination of detail." The author approves of indirect lighting in all other situations. Some remarks are added about invisibility of troops, the visibility of light-houses, etc.

Troland (**24**) describes the theory and practice of the artificial pupil, an indispensable piece of apparatus of which the reviewer has hitherto seen no careful account. The model designed by the author, and here described, is binocular and provides rapid and accurate means for securing concentric registration between the artificial and the natural pupils. From the theoretical discussion it appears that no artificial pupil can be used where the stimulus object subtends an angle of more than about 53°. Dunlap (**6**) describes an interesting new device, the "duoscope," for testing visual acuity. It seems to be "not sensitive to brightness changes over a considerable range"; but it is sensitive to adaptation changes, and may be found useful as an adaptometer. It is specially adapted for detecting slight degrees of astigmatism.

Abderhalden and Wildermuth (**1**) describe the photoelectric potassium cell as an objective recorder of brightness differences. Light alters the resistance of the selenium cell, but sets up an electromotive force in the potassium cell. The authors find that the potassium cell will record brightness differences which are absolutely invisible to the eye. It is subject to the Weber-Fechner law, but this is no practical drawback. For colorimetry it has a (color) range both above and below that of the eye. The technique of the potassium cell is at present rather tedious and exacting, but the authors believe that many of the difficulties can be overcome. Johnson (**18**) offers a valuable method for obtaining several monochromatic stimuli with the aid of light filters. The ordinary spectrometer system will give only very little light of any one color, while most light filters give much more light, but it is far from being monochromatic. If the mercury vapor arc is used, its four very bright and narrow bands (violet, blue, green, and yellow) can be individually isolated by the use of filters, which are here described. A practically pure red can be had by using a certain ruby glass. It is perhaps worth noting, however, that not all mercury vapor lamps can be held at constant intensity.

References

1. Abderhalden, E. & Wildermuth, F. Die Verwendung von Kaliumzellen zur objektiven Vergleichung der Tontiefe farbiger Lösungen und zur Feststellung von Helligkeitsunterschieden. Pflüger's *Arch. f. d. ges. Physiol.*, 1914, **159**, 585–606.
2. Baley, S. Mitteilungen über das Sehen der Farben bei halbgeschlossenen Augen. *Zsch. f. Sinnesphysiol.*, 1915, **49**, 79–84.
3. Bender, H. Untersuchungen am Lummer-Pringsheimschen Spektralflicker-photometer. *Ann. d. Physik.*, 1914, **45**, 105–132.
4. Blachowski, S. Tachistoskopische Untersuchungen über den elementaren Wahrnehmungsvorgang bei Dunkeladaptation. *Zsch. f. Sinnesphysiol.*, 1914, **48**, 325–353.
5. Day, E. C. Photoelectric Currents in the Eye of the Fish. *Amer. J. of Physiol.*, 1915, **38**, 369–398.
6. Dunlap, K. A New Measure of Visual Discrimination. *Psychol. Rev.*, 1915, **22**, 28–35.
7. Dunlap, K. Color Theory and Realism. *Psychol. Rev.*, 1915, **22**, 99–103.
8. Dunlap, K. The Shortest Perceptible Time-Interval between Two Flashes of Light. *Psychol. Rev.*, 1915, **22**, 226–250.
9. Edridge-Green, F. W. The Simple Character of the Yellow Sensation. *J. of Physiol.*, 1915, **49**, 265–270.
10. Ferree, C. E. Untersuchungsmethoden für die Leistungsfähigkeit des Auges bei verschiedenen Beleuchtungssystemen, und eine vorläufige Untersuchung über die Ursachen unangenehmer optischer Empfindungen. *Zsch. f. Sinnesphysiol.*, 1915, **49**, 59–78.
11. Ferree, C. E., & Rand, G. A Preliminary Study of the Deficiencies of the Method of Flicker for the Photometry of Lights of Different Color. *Psychol. Rev.*, 1915, **22**, 110–162.
12. Ferree, C. E. & Rand, G. A Résumé of Experiments on the Problem of Lighting in its Relation to the Eye. *J. of Phil., Psychol. &c.*, 1915, **12**, 657–663.
13. Gates, E. J. On Intensive and Qualitative Judgments of Light Sensations. *Amer. J. of Psychol.*, 1915, **26**, 296–299.
14. Hartridge, H. Interest as a Factor in Antagonism and Simultaneous Contrast. *J. of Physiol.*, 1915, **50**, 47–64.
15. Hering, E. Das Purkinjesche Phänomen im zentralen Bezirke des Sehfeldes. *Arch. f. Ophth.* (v. Graefe), 1915, **90**, 1–12.
16. Hunter, W. S. Retinal Factors in Visual After-Movement. *Psychol. Rev.*, 1915, **22**, 479–489.
17. Ives, H. E. & Brady, E. J. A New Design of Flicker Photometer for Laboratory Colored Light Photometry. *Phys. Rev.*, 1914, **4**, 222–227. (Not accessible to the reviewer.)
18. Johnson, H. M. Monochromatic Stimuli Obtained by Means of Filters. *Psychol. Bull.*, 1915, **12**, 123–125.
19. Lohmann, W. Ueber die "binokulare Reizsummirung" bei Untersuchung der Lichtschwellen. *Arch. f. Augenheilk.*, 1915, **74**, 110–116.
20. Miles, G. H. The Formation of Projected Visual Images by Intermittent Retinal Stimulation: I. *Brit. J. of Psychol.*, 1915, **7**, 420–433; II., 1915, **8**, 93–126.
21. Paterson, C. C. Visibility. *Nature*, 1915, **95**, 397–398.

22. SCHAEFER, K. L. Ueber die Kongruenz des psycho-physiologischen Verhaltens der unerregten Netzhautgrube in der Dämmerung und des blinden Fleckes im Hellen. PFLÜGER'S *Arch. f. d. ges. Physiol.*, 1915, **160**, 572–580.
23. SMITH, S. J. Visual Quality as a Determinant of Clearness. *Amer. J. of Psychol.*, 1915, **26**, 449–453.
24. TROLAND, L. T. The Theory and Practice of the Artificial Pupil. *Psychol. Rev.*, 1915, **22**, 167–176.
25. WEBER, A. E. Ueber die Anwendung des rotierenden Sektors zur photographischen Photometrie. *Ann. d. Physik*, 1914, **45**, 801–838.
26. ZIPKIN, D. Ueber die Wirkung von Lichtlücken auf grössere Netzhautbezirke. *Zsch. f. Sinnesphysiol.*, 1915, **49**, 89–98.

VISION—COLOR DEFECTS

BY SAMUEL P. HAYES

Mount Holyoke College

The question of color-tests is still engaging the attention of a number of Europeans of wide experience in this line. Edridge-Green (**2**) writes that, although the tests introduced by the English Board of Trade in 1913 have resulted in a larger proportion of rejections than ever before (an advance from less than 2 per cent. to nearly 5 per cent., the inadequacy of the present tests is clearly shown by the fact that in 1913 among 286 rejected, 93 appealed and 26 of these were accepted. In Germany where the Nagel *Tafeln* are widely used as a preliminary test, there is great difference of opinion as to whether this test alone can be depended upon to detect all dangerous cases. Horniker (**4**) recommends the use of the Stilling and Nagel tests together; Augstein (**1**) recommends the use of the Stilling and Cohn *Tafeln*, laying great stress upon the latter. Rosmanit (**8**) makes the main contribution of the year in a volume which should be on the desk of every investigator in this line. He gives first a careful review of the spectral work upon color defectives, then a detailed description of the Nagel anomaloscope, directions and hints for the practical diagnosis of color defects by means of the anomaloscope, and a summary of the conditions under which subjects should be judged eligible for service where color decisions must be made. He recommends the use of the Stilling and Nagel *Tafeln* as preliminary tests, to be followed by a test with the anomaloscope in all doubtful cases.

The lower degrees of color defect are now receiving an amount of attention which promises well for the ultimate classification of these puzzling cases. Parsons (**7**) gives a brief historical review of the

investigation of anomalous trichromatic vision, in his book on *Colour Vision*—a book which is by far the most complete and scholarly treatment of the facts and theories of color vision which has ever been published in English; Rosmanit (**8**) gives a much more detailed treatment, showing the results obtained in testing 440 anomalous trichromates with the Nagel anomaloscope, and with the Nagel and Stilling *Tafeln*. After an interesting review of the discussion concerning the relation of this group to those who show color-weakness in the various ways outlined by Guttmann,[1] Rosmanit classifies color defectives that are not dichromates into three groups—(*a*) typical anomalous trichromates who demand an abnormal amount of red or green in the spectral equation red + green = yellow (commonly called the Rayleigh equation), and *also* show decided color-weakness; (*b*) pure spectral anomalous trichromates who demand an abnormal spectral equation but do not show color-weakness; and (*c*) color-weak trichromates who accept the normal spectral equation. The great majority belong to class (*a*). Rosmanit considers individuals of classes (*a*) and (*c*) too defective for positions on railroads or steamships, while those of class (*b*) might safely be accepted.

Köllner (**5**) reports the results of an attempt to classify anomalous trichromates quantitatively, by the use of the Nagel anomaloscope. It is generally known that normal persons accept an equation of red + green = yellow which is practically the same for all, that anomalous trichromates do not accept the normal equation, but insist either upon more red or more green, while dichromates accept the normal equation and wide variations from it in both directions. Köllner finds that among the anomalous trichromates he has studied, some insist upon a very definite mixture of red and green while others accept variations either toward the red or the green, which gives a result similar to that of some dichromates. These results are graphically presented, by the use of charts, and clearly demonstrate his conclusion that a considerable number of anomalous trichromates can be arranged in series, one group passing from the deuteranomalous trichromates with a very restricted Rayleigh equation, through those accepting more and more of red or green, to deuteranopes; the other group passing from protanomalous trichromates with a very restricted Rayleigh equation through transition forms to protanopes. Between normal and

[1] GUTTMANN, A., "Untersuchungen über Farbenschwäche," *Zsch. f. Sinnesphysiol.*, 1908, **42**, II, 24–64, 250–270; **43**, II, 146–162, 199–223, 255–298.

anomalous trichromates Köllner finds no indisputable transition forms, but suggests that one might consider as such, a third type which his researches have discovered—subjects which at first seem to have a restricted normal Rayleigh equation, but who fatigue so quickly to color that they soon accept great variations from the normal, in some cases approximating the wide range of mixtures characteristic of dichromates. Köllner, like Rosmanit, finds color weakness quite common among anomalous trichromates, though he also reports that among his subjects those who accept the widest variations in the Rayleigh equation often show the least evidence of color-weakness. These cases remind one of Rosmanit's pure spectral cases.

Watson (9) reports the results of testing anomalous trichromates with white light passed through 0.8 cm. of saturated solution of chromate of potash. His cases fall into classes somewhat resembling those found by Köllner. It is to be hoped that the author will later publish his results with the Rayleigh equation that a comparison with the work of Köllner, Rosmanit and their predecessors may be facilitated.

Hegner (3) reports upon a student with a color defect limited to the left eye. After tests with the Nagel and Stilling *Tafeln* and the Nagel anomaloscope, Hegner diagnoses the defect as extreme protanomalous trichromasy; and since the subject's testimony showed that, at an earlier date, he had had difficulty in distinguishing colors with the right eye while using the microscope, Hegner raises the interesting question whether this subject may not have been born with a *functional* defect in the color apparatus which has been corrected in one eye by use, as occasionally occurs in patients with congenital amblyopia. Hegner proposes to test this hypothesis by systematic education of the subject's defective left eye. Hegner further reports that among 50 men tested he found 3 dichromates, 2 monocular anomalous trichromates—one a typical case, the other a purely spectral case without any evidence of color-weakness—and a number of subjects with slight color deficiency.

Usher (6) publishes three pedigrees of color-blindness upon which work had been begun by the late E. Nettleship. The first pedigree is of theoretical importance since it includes 3 color-blind women and a 4th with some slight color defect. In none of these cases has color-blindness been proved to come through both parents as one would expect, but as there is not sufficient data it cannot, on the other hand, be asserted that the inheritance has come through only one

parent. In two instances the fathers of the color-blind women were color-blind, while in a third instance the mother belonged to a stock containing color-blindness. Usher's second pedigree contains 7 color-blind men, one of whom is a twin. Here the inheritance seems according to rule in every case. Usher's third pedigree is an extension of one published by Pliny Earle in 1845. This is now the largest pedigree of color-blindness on record, including 443 individuals distributed through 8 generations.

REFERENCES

1. AUGSTEIN, —. Bemerkungen zur Farbensinnuntersuchung. *Zsch. f. Augenhlk.*, 1912, **28**, 347–355.
2. EDRIDGE-GREEN, F. W. An analysis of the results of the new sight tests of the Board of Trade. *Brit. Med. J.*, 1914, 388–389.
3. HEGNER, C. A. Über angeborene einseitige Störungen des Farbensinns. *Zsch. f. Sinnesphysiol.*, 1914, **49**, 18–28. Also published in *Klin. Monatsblätter f. Augenhlk.*, 1915, **56**, 81–89.
4. HORNIKER, E. Bemerkungen zur Farbensinnprüfung. *Zsch. f. Augenhlk.*, 1913, 30, 122–132.
5. KÖLLNER, H. Ueber Uebergänge zwischen normalen Farbensinn und angeborener Rotgrünblindheit und über die Möglichkeit ihrer quantitativen bestimmung. *Arch. f. Augenhlk.*, 1915, **78**, 302–335.
6. NETTLESHIP-USHER. Pedigrees of Colour-Blindness. *Rep. Roy. Lond. Oph. Hosp.*, 1915, **20**, 1–15.
7. PARSONS, J. H. *An Introduction to the Study of Colour Vision.* Cambridge: University Press, 1915. Pp. viii+308.
8. ROSMANIT, J. Anleitung zur Feststellung der Farbentüchtigkeit. Wien: Deuticke, 1914. Pp. vi+195.
9. WATSON, W. On anomalous trichromatic colour vision. *Proc. Roy. Soc.*, 1914, A **90**, 443–448.

TASTE AND SMELL

BY ELEANOR A. McC. GAMBLE

Wellesley College

Careful experiments in taste reaction time are reported by Chinaglia (1). His purpose was to determine the effect of temperature change in the rapid solutions upon sensitiveness to the various tastes. He began his work by verifying the fact, discovered by Kiesow, that raising or lowering the temperature of the solution between the points where the heat and cold become painful has no effect upon the intensive stimulus limen. A simple appliance which he used in these experiments is well worth noting. It con-

sisted of a U-formed glass tube with one long arm. The hook of the tube, which contained a definite quantity of liquid, could be kept almost immersed in the warm or cold solution even during the moment when the subject was drawing the liquid into his mouth. From this work Chinaglia proceeded to measure the reaction time to taste solutions of various temperatures. The subjects knew in every case the nature of the taste to which they were to react. The temperature of none of the solutions was such as in itself to produce pain. Chinaglia's findings in regard to the result of raising the temperature of the solution above that of the mouth or lowering it beyond this point are as follows: In the case of salt, change of temperature has no effect on reaction time. Lowering the temperature lengthens the time of reaction to the other three tastes. Raising the temperature shortens the time for sweet but lengthens it for bitter and, in a very marked degree, for sour. Chinaglia traces this peculiarity of the reaction to sour to an increase in the bite of the acid, an increase which obscures the taste quality and delays recognition. In conclusion, he stresses the fact that an effect of high and low temperatures upon sensibility to taste is clearly demonstrable in terms of reaction time though not in terms of the stimulus threshold.

Henning (**2**) appears to be in process of making the most important contribution to the psychology of smell which has appeared in recent years. But only the first installment of his work is as yet in print, and, in the absence of adequate experimental detail and numerical data, it is impossible to estimate the soundness of his conclusions. His attitude toward earlier work (with which he shows an extensive acquaintance) is minutely critical and, in the main, destructive. He begins his paper with an introduction upon the crying need for a classification of smells upon truly psychological principles. Next comes a section (Section 1) dealing at length with his own subjects, some of whom were experts in smell discrimination; dealing briefly with the 415 scents which constituted his experimental material; and dealing far too briefly with his olfactometric procedure. His instruments included three forms of olfactometer but practically no details are given in regard to the applicances and concentrations used, or in regard to the number or time-order of stimuli given at a sitting in any particular set of experiments. Section 2 deals "with dirhinic, dichorhinic, and monorhinic smelling," that is, with smelling in which the same stimulus is applied to both nostrils, in which different

stimuli are applied to different nostrils, and in which a single stimulus is applied to a single nostril. In his insistence on the inadequate perception of quality obtained by monorhinic smelling, he makes a point of great importance. He rightly urges that if monorhinic smelling is unsatisfactory, dichorinic smelling cannot be a satisfactory way of obtaining mixture of smells. He believes, moreover, that the necessity for "procedure with knowledge" in olfactometric work is entailed simply by the customary practice of presenting the stimulus to one nostril at a time. Section 3 discusses the sensations of warmth, cold, pressure, pungency and taste which may blend with the true sensations of smell and points out the situations in which they are localized. Section 4 is the portion of the work valued most highly by the reviewer. Here Henning points out the illusions which may arise when the subject knows beforehand the exact nature of the stimulus which is presented to him. A sharp distinction is to be drawn between the true smell quality (*Gegenheitsgeruch*), which is perceived by a subject smelling with closed eyes and ignorant of the nature of the stimulus, and the object-smell (*Gegenstandsgeruch*), which is perceived when the subject knows just what he is getting. The former is ordinarily localized within the nose; the latter is projected, like a color, upon an extra-bodily object and is likely to be distorted by memory and expectation. Of this distortion Henning gives excellent illustrations.

Sections 6 and 7 deal with Henning's own experiments in smell similarity. Details of experimental procedure are extremely meager. Unanimity between the subjects was his test of correctness of judgment. Sections 5 and 8 treat respectively of smell terminology and of other classifications than Henning's own. In the opinion of the reviewer, his unflattering appraisal of the method by which Zwaardemaker has remodelled the classification of Linnæus is not entirely fair. Section 9 gives the details of Henning's own classification and develops his conception of a smell-prism which shall present the interrelation of odors as the color pyramid symbolizes the interrelation of colors. The angles and edges of this prism are all equal. At the six angles should stand the best representatives (not yet determined) of Henning's six classes of smells —spicy, flowery, fruity, resinous, putrid, and empyreumatic or scorched (*brenzlich*). This classification is based upon his experiments in smell similarity and upon other experiments, very briefly described in this section, in which subjects were given a number of scents and were required to arrange the similar ones in a series and

to throw out the others. The following odors are typical of the six classes: nutmeg, violet, lemon, frankincense, sulphuretted hydrogen, and tar. The exact assignment of the several classes to the several prism-angles is immaterial, since there is a gradual transition from every class into every other class. The edges of the prism should be thought of as occupied by intermediate smells and the classes which stand diagonally opposite to one another upon the rectangular faces must be connected with one another by diagonal lines across the several faces. The following are instances of transition-smells: between spicy and flowery, thyme and vanilla; between flowery and fruity, geranium; between fruity and resinous, the piney odors; between resinous and putrid, fish-scales; between putrid and empyreumatic, various ammoniacal animal fetors; between empyreumatic and spicy, roasted coffee; between putrid and spicy, garlic; between spicy and fruity, peppermint. The whole outer surface of the pyramid is supposed to be occupied by simple smells; its inside is reserved for mixtures. (By a mixed smell, Henning evidently means a smell derived from a physical mixture of odorous substances.) Although the smells at the corners of the prism are related to one another like the colors at the angles of the pyramid, yet the smells upon a given line are interrelated like the tones in the tonal scale and not like the colors upon an edge of the pyramid. For if two colors belonging to the same scale are mixed, the result will be an intermediate in this same scale, whereas if two smells in a series are mixed, the result, according to Henning, will be a chord-like blend. (There is an obvious geometrical difficulty in placing anywhere within the prism a mixture of two smells standing on the same edge or face, but no figure can do entire justice to the complex relations either of colors or of smells.)

Henning promises to present certain facts of chemistry in corroborations of his classification of smells. In the meantime, his prism will gain the attention of every one who is interested either in such constructions or in the psychology of smell. But its very neatness is against it and it will not win general acceptance until its maker brings forward a more formal and formidable array of experimental data.

References

1. Chinaglia, L. Ricerche intorno all'influenze esercitata dalla temperatura sulla sensibilità gustativa. *Riv. di psicol.*, 11: 196–226.
2. Henning, H. Der Geruch, I. *Zsch. f. Psychol.*, 73: 161–257.

CUTANEOUS AND KINÆSTHETIC SENSES

BY JOHN TRUMBULL METCALF

Princeton University

Work on the cutaneous sensibility of skin areas supplied by regenerating nerves is continued by Hacker (**8**). He renders anæsthetic an area of about 15 sq. cm. on the volar surface of his left forearm by the injection of a solution of iodine. The anæsthesia of this area is due not to the spread of the solution, but to the injury by the solution of the nerve which supplies it. The anæsthesia persisted for about two months after the injection, and then regeneration phenomena began to appear. The area was carefully tested for the various kinds of cutaneous sensibility during the period of regeneration. After 14 weeks the area was found to have regained its normal number of sensitive points except for the pain points, and it took two weeks more for these entirely to reappear. Throughout the whole course of the investigation the sense points, as they regained their sensibility, always appeared with normal thresholds. The author compares his results with those of Head,[1] and of Trotter and Davies,[2] and he finds several points of disagreement. In both the investigations cited an intermediate zone was found between the affected area and the normal skin, a zone in which the threshold of the sense points was higher the nearer the affected area was approached. This zone Hacker does not find. He does find that the sense points on the edge of the affected area are fewer in number than in the normal skin, but with careful investigation these points are all found to have perfectly normal thresholds. Trotter and Davies reported that during the period of regeneration certain sensations aroused in the affected area were peculiarly intense (intensification), and also that during this period a stimulus to the affected area tended to be localized on its edge (peripheral reference). Hacker finds neither intensification nor peripheral reference during the period of regeneration, though he does get results which correspond to each of these phenomena just outside the border of the affected area before regeneration has begun.

If a weight be placed upon the skin it arouses at first a clear sensation which then becomes less and less clear. The temporal course of this fading out is made the subject of an investigation by

[1] Rivers, W. & Head, H., "A Human Experiment in Nerve Division," *Brain*, 1908, 31, 323–450.

[2] Reported in this Bulletin, 1914, 11, 153.

v. Frey and Goldmann (7). The arrangement of the experiment provides for the giving of two stimuli, a continuous stimulus lasting four seconds, during which time the sensation it arouses fades, and a momentary stimulus given at a certain varying length of time after the beginning of the continuous stimulus. If the sensations from the two stimuli are equal in intensity at the time the momentary stimulus taps in, then the intensity of the momentary stimulus represents the point reached by the sensation from the continuous stimulus in its process of fading out. The area of the continuous stimulus is varied, as is also its strength. The fading out of the sensation is found to be very rapid at first, but progressively less so. At the end of four seconds the continuous stimulus is giving a sensation only one eighth as intense as at the start. The sensation fades more slowly with increase in the strength or in the area of the continuous stimulus. v. Frey (6) also makes a study of the feeling of vibration, using tuning-forks of from 60 to 100 vibrations per second to arouse the sensations. He feels justified in concluding from his results that the sense-organs which mediate the feeling of vibration are the pressure receptors in the skin. When the tuning-fork is placed in contact with a bone the feeling of vibration is increased in intensity. This is explained by the fact that the bone, while it dulls the impulses very little, makes possible their wide spread over broad skin surfaces, and in this way a greater number of pressure receptors are brought into play.

Dimmick (4) investigates the localization of warmth sensations, using as a stimulus radiant heat from a loop of platinum wire electrically heated. This stimulus was devised to secure a means of arousing sensations of warmth without accompanying sensations of pressure. The error of localization is found to be very large as compared with that of a control series of pressure experiments. In the case of warmth sensations there are revealed very noticeable tendencies of direction in localization. The tendency is always inward from the edges of the area investigated.

A study of pain sensations on different parts of the body is made by Becher (1). He accepts the distinction between sharp, superficial and dull, deeper-lying pain qualities. His present purpose is to determine empirically whether pain sensations of the former kind are all of the same quality or if different qualities can be distinguished. With various kinds of pointed stimuli the whole surface of the body is explored, the author himself acting for the most part as the only subject. The pain sensations aroused by stimulation

of the ordinary white skin, whether covered with hair or not, are found to be everywhere the same in quality. There are, however, parts of the body which give sensations that are recognized as of different quality. This is especially true of the inside of the auditory canal. Another study of cutaneous pain is made by Carati (3). He studied the affected skin areas in a number of cases of organic lesions of peripheral nerves to determine the pain sensitivity of these areas to the faradic current. The areas were explored with a needle electrode, and they were also carefully gone over with pressure and temperature stimuli for purposes of comparison. It is found that the areas affected in one way or another for faradic pain sensibility are always more extended than the areas of similar change for pressure and temperature sensibility.

Martin, Paul, and Welles (9) compare the threshold of faradic stimulation of the eye-wink reflex with the sensory threshold for faradic stimuli to the same spot on the lower eyelid. The sensory threshold is found with both the subjects used to be markedly lower than the reflex threshold. The sensory threshold is also much less constant than the reflex threshold.

Two studies have appeared on the central conduction of impulses originating in the cutaneous sense organs. Spiller (12), on the basis of a long period of observation of clinical cases, gives a summary of his conclusions on the central representation of cutaneous sensations. Brouwer (2) also concerns himself chiefly with the central conduction of cutaneous impulses. He relates his discussion to the segmental theory, and compares the distribution of nerves to corresponding skin areas in different species. Two studies have appeared which describe disturbances of cutaneous sensation due to injuries to the central nervous system, the patients being wounded soldiers. Rothmann (11) reports a case of injury to the spinal cord in the thoracic region as a result of which the patient's right leg has become perfectly insensitive to thermal stimuli, other forms of cutaneous sensibility remaining normal in the affected area, and the remainder of the body reacting normally to all forms of cutaneous stimulation. Redlich (10) reports observations on five cases of cerebral hemianæsthesia. He finds that the skin of half the trunk and head has become insensitive to all forms of cutaneous stimulation. The border-line of the affected area is almost the exact median line of the body. Two or more zones can usually be found on the affected side bordering on the middle line in which sensibility is not entirely gone. In these zones the sensibility shades off, growing less with greater distance from the middle line.

v. Frey (5) continues his valuable work on the muscle sense with some more experiments on the comparison of weights. It is well known that tossing a weight in the hand is preferred as a method of judging it to simply lifting it. The author experiments with both of these methods. In the lifting experiments he makes use of the leather-covered plaster cast of his previous experiments.[3] He calculates the difference-sensitivity for the muscle sense in two different ways. First there is the practical difference-sensitivity which is expressed in terms of the weights and their difference. Then there is also the true difference-sensitivity, expressed in terms of the amounts of muscle strain required to raise the weights. The latter is a physiological constant and is the more significant value for physiology and psychology. The results obtained in the experiments in which the weights were tossed show that this method of judging them is more accurate than the lifting method. Apparatus is devised to analyze the tossing movement, and it is found that here, as in the lifting experiments, the judgment of the weights is made on the basis of the muscle strain involved. The chief reason for the superiority of the tossing method the author finds in the short time that the muscles are in play. Fatigue is less, the subject has rhythmical repetitions of the stimulus, and the sensations to be compared are brought closer together in time.

References

1. Becher, E. Ueber Schmerzqualitäten. *Arch. f. d. ges. Psychol.*, 1915, **34**, 189–207.
2. Brouwer, B. Die biologische Bedeutung der Dermatomerie. Beitrag zur Kenntnis der Segmentalanatomie und der Sensibilitätsleitung im Rückenmark und in der Medulla Oblongata. *Folia Neuro-biol.*, 1915, **9**, 225–336.
3. Carati, E. Recherches Cliniques sur la Sensibilité Douloureuse Farado-cutanée. *Rev. neur.*, 1915, **22**, 296–304.
4. Dimmick, F. L. On the Localization of Pure Warmth Sensations. *Amer. J. of Psychol.*, 1915, **26**, 142–150.
5. v. Frey, M. Die Vergleichung von Gewichten mit Hilfe des Kraftsinns. *Zsch. f. Biol.*, 1915, **65**, 203–224.
6. v. Frey, M. Physiologische Versuche über das Vibrationsgefühl. *Zsch. f. Biol.*, 1915, **65**, 417–427.
7. v. Frey, M., & Goldmann, A. Der zeitliche Verlauf der Einstellung bei den Druckempfindungen. *Zsch. f. Biol.*, 1915, **65**, 183–202.
8. Hacker, F. Ein Beitrag zum Studium der Regeneration von Hautnerven. *Zsch. f. Biol.*, 1915, **65**, 67–78.
9. Martin, E. G., Paul, B. D., & Welles, E. S. A Comparison of Reflex Thresholds

[3] Reported in this Bulletin, 1915, **12**, 116.

with Sensory Thresholds—the Relation of this Comparison to the Problem of Attention. *Amer. J. of Psychol.*, 1915, **26**, 428–437.

10. Redlich, E. Zur Topographie der Sensibilitätsstörungen am Rumpfe bei der zerebralen Hemianästhesie. *Neur. Centbl.*, 1915, **34**, 850–856.

11. Rothmann, M. Ueber isolierte Thermalgesie eines Beines nach Schussverletzung des obersten Brustmarks. *Neurol. Centbl.*, 1915, **34**, 153–157.

12. Spiller, W. G. Remarks on the Central Representation of Sensation. *J. of Nerv. & Ment. Dis.*, 1915, **42**, 399–418.

SPECIAL REVIEWS

The Circulation and Sleep. J. F. Shepard. New York; Macmillan, 1914. Pp. 83, with atlas of 63 plates.

This painstaking study of sleep and correlated physiological phenomena is the most ambitious work attempted since the well-known studies of Mosso published in 1881. The experiments covered two school years and were performed chiefly upon two subjects, the trephining of whose skulls allowed of direct study of brain pulsations by means of brain plethysmographs. Special apparatus was designed for each subject and conditions so adjusted that accidental factors were either eliminated, controlled or compensated for. Careful introspective reports were tabulated with the kymograph records, and the author is guarded in his generalizations.

Studies were made of the brain volume, of the peripheral circulation, and of the breathing curve, with the subject sleeping in various positions: upright, on his back, side, and so on. Further tests of blood pressure, heart rate, pulse-transmission time, the jugular pulse, the pulse-form, and the influence of certain drugs upon the circulation, are also recorded, the last only briefly.

A separate *atlas* of sixty-three plates accompanies the volume, and the book itself is devoted chiefly to an interpretation and explanation of these charts. The author presupposes a rather technical knowledge of the literature of his topic which will make the investigation effortful reading to any but the student of allied problems versed in its terminology.

Shepard finds the volume of the brain always increased at the inception of sleep, with an accompanying increase of the arterial pulse. Subliminal stimuli and the processes of awakening bring a fall of brain volume. So far as investigated, the physiological effect of dreams was ambiguous. Blood-pressure is lowered during sleep, disturbances of any sort causing a rise. The transmission

of the pulse wave is slower in sleep, although the study of the venous system yielded negative results.

Of more general interest in his conclusion that there is an active, effective vaso-motor control of the brain vessels in man, under normal conditions, and that similar control is exercised over the respiratory wave, contrary to the usual assumption. The author rejects the anæmic theory of sleep (sleep as due to the separation of dendrites and axones by expansion of the cerebral vessels, for instance), first, because there are large increases in brain volume with stimuli while awake; in the second place because it appears demonstrable that circulatory changes so far as recorded in his charts, always lag behind mental processes involved (compare figs. 40 and 41 in the atlas). He therefore regards the relaxation of the brain vessels with sleep (and their constriction with awakening) as an effect rather than as a cause of the sleep process.

As to the psychology of sleep, suggestion and quieting environment effect a usual, but not indispensable, precondition of sleep. The content of sleep is described as a "group of sensations of fatigue or rest" —this from introspective reports—and sleep is therefore characterized as a "more complete rest" in which these sensations assume increasing dominance in attention and so, ultimate control.

The book and its atlas in binding and general appearance are a distinct contribution to monograph studies. The work was done at the University of Michigan, is copyrighted by them, and forms Volume I of the Scientific Series, University of Michigan Studies.

ELIOTT PARK FROST

UNIVERSITY OF TENNESSEE

The Criminal Imbecile. H. H. GODDARD. New York: Macmillan, 1915. Pp. 157.

The following chapter titles appear in this little book: The Case of Jean Gianini, The Case of Roland Pennington, The Case of Fred Tronson, The Criminal Imbecile, Responsibility, The Punishment for Criminal Imbeciles. Following these chapters are three appendices: (*a*) The hypothetical question propounded by the defense in the Gianini Case; (*b*) the hypothetical question propounded by the prosecution in the same case; (*c*) defendant's request to judge in the same case.

Dr. Goddard is using the word "imbecile" in this book in the legal sense. It includes the moron and often the idiot as scientifically classified. The cases which he describes here are the first

court cases in which the Binet-Simon tests have been admitted as evidence. By means of these tests the mental age of the persons on trial was determined. These chapters are clearly written. This, together with the nature of the matter presented, should make them useful to those members of the legal profession who earnestly seek for a better understanding of the cases that come before them from time to time.

In the chapter on "Responsibility" Dr. Goddard discusses his cases in the light of the legal criterion of responsibility. To be responsible one must know the nature and the quality of one's act. Dr. Goddard begins this chapter with this sentence: "All students of the psychology of childhood agree that not until the dawn of adolescence does reasoning, as such, begin to show itself in the child mind; the judgment and foresight and self-control, such as enable a person to counteract his natural impulses and make himself fit into the conventions of society, are practically unknown previous to this age." This statement seems to the reviewer to be saying a good deal for the psychologists. The reviewer believes that a statement to the following effect would not be far from the truth: "No competent student of psychology believes that the normal pre-adolescent is lacking in those processes that are essential to reasoning; every normal child, before he has reached the adolescent stage has acquired many inhibitions such as counteract or tend to counteract his natural impulses and make him fit into the conventions of society." Psychologists certainly have got past the point of blocking off human development into definitely market segments; nobody believes that here or there is the definite cross-section on the one side of which reasoning begins. As soon as one begins to analyze one's experiences and to compare these experiences with others and to make statements based upon such comparisons, one has begun to reason. It looks as if the author of the book under review may have made himself believe the substance of the first sentence in this chapter on responsibility in order that he might show deductively that children under twelve are in no measure responsible in the legal sense and consequently that adults whose mental age is under twelve are likewise not responsible in the legal sense. Indeed this inference as to adults is stated in the next to the last sentence in the chapter.

In the same chapter, the author makes the statement that persons of the mentality of one under twelve do not know much about right and wrong; they act upon impulse and upon instinct without very much thought. Certainly we say that no one of us knows

much about right and wrong in the abstract. We think that particular acts are wrong; we have a feeling that such and such acts are wrong and that others are right. This attitude of ours has grown up in us very largely in consequence of the circumstances in the midst of which we have lived. Without a capacity for such an acquisition to begin with, it goes without saying that the acquisition could not be gained. The young man who has never entered into business relations with his fellows has no feeling for the wrongness of overdrawing his account at the bank. It does not enter his consciousness that there can possibly be any wrong about it. He has the capacity, however, for understanding the relations that are involved in such an act, and he arouses with a start when it is pointed out to him that he is borrowing without even saying "By your leave"; that he is therefore making use of what does not belong to him.

The point I am trying to lead up to is this: that it is not necessary, even for practical purposes, that we labor with ourselves to determine when one becomes aware of the nature and quality of one's act. We never become fully aware of this; at best, we become aware of it only in spots. The only sensible question for us to ask when we are faced with the problem of an individual's responsibility is this: Is he capable of developing suitable adaptations to the social environment in which he lives or not? Specifically, is he capable of being made to realize that it is wrong to steal or to commit murder? And have the opportunities that the subject has had in the course of his educational history up to date been such as should normally have enabled him to make such adaptations? In other words, the question of responsibility is a question of educability, using this term in its broad sense. It is strange language for a psychologist, when he discusses the question whether Jean Gianini knew the nature and the quality of his act; it is stranger still when we hear this same psychologist saying that he did not know the nature and quality of his act, because such knowledge implies reasoning and reasoning is not to be found among persons whose mental age is below twelve.

ROBERT H. GAULT

NORTHWESTERN UNIVERSITY

DISCUSSION

ASSOCIATION TEST AND PERSONALITY

Professor Whipple writes as follows on p. 54 of his new *Manual*:[1]

"Woodworth and Wells, for example, talk of the free association test as having achieved, and being likely to retain, a place in the foremost rank among the methods of individual psychology, and assert that the form of it developed by Kent and Rosanoff gives perhaps the best objective correlate of temperament at present to hand, and that it has 'established a definite standard of normality'—statements that are hard to understand in the light of the results established to date."

Subjoined are references, in addition to those given by Professor Whipple, which are of particular interest in this regard:

APTEKMANN, E. Experimentelle Beiträge zur Psychologie des psychogalvanischen Phänomens. *Jahrb. f. Psychoanal. u. psychopathol. Forsch.*, 1912, 591–620.

BIRNBAUM, K. Über den Einfluss von Gefühlsfaktoren auf die Assoziationen. *Monat. f. Psychiat. u. Neur.*, 1912, **32**, 95–133, 194–220.

FÜRST, E. Statistische Untersuchungen über Wortassoziationen u. über familiäre Übereinstimmung im Reaktionstypus bei Ungebildeten. *J. f. Psychol. u. Neur.*, 1907, **9**, 243–278.

JUNG, C. G., & RIKLIN, F. Experimentelle Untersuchungen über Assoziationen Gesunder. *J. f. Psychol. u. Neur.*, 1904, **3**, 55–83, 145–164; 1904–1905, **4**, 24–67.

LANG, J. B. Über Assoziationsversuche bei Schizophrenen und den Mitgliedern ihrer Familien. *Jahrb. f. Psychoanal. u. psychopathol. Forsch.*, 1913, 705–755.

LANG, J. B. Zur Bestimmung des psychoanalytischen Widerstandes. *Psychol. Abhand.*, 1914, **1**, 1–35.

LANG, J. B., Eine Hypothese zur psychologischen Bedeutung der Verfolgungsidee. *Psychol. Abhand.*, 1914, **1**, 35–52.

PFENNINGER, W., Untersuchungen über die Konstanz und Wechsel der psychologischen Konstellation bei Normalen und Frühdementen (Schizophrenen). *Jahrb. f. Psychoanal. u. psychopathol. Forsch.*, 1911, **3**, 481–524.

RITTERSHAUS, E., Die Komplexforschung. *J. f. Psychol. u. Neur.*, 1910, **15**, 61–83; 184–220; **16**, 1–43.

[1] WHIPPLE, G. M. *Manual of Mental and Physical Tests.* 2 ed., Part II: Complex Processes. Baltimore: Warwick & York, 1915.

These appear mainly, not entirely, in accord with the experience[2] leading to the generalization to which Professor Whipple's objections are raised.

F. L. WELLS

McLEAN HOSPITAL

BOOKS RECEIVED

SEASHORE, C. E. *A Child Welfare Research Station.* Iowa City: Univ. of Iowa, 1915. Pp. 18.

LYON, D. O. *The Relation of Quickness of Learning to Retentiveness* Pp. v + 60. 50 cents. (Arch. of Psychol., No. 34.)

MORGAN, J. J. B. *The Overcoming of Distraction and Other Resistances.* New York: Science Press, 1916. Pp. v + 84. 75 cents. (Arch. of Psychol., No. 35.)

DODGE, R. & BENEDICT, F. G. *Psychological Effects of Alcohol.* Washington, D. C.: Carnegie Inst. of Washington, 1915. Pp. 281.

SLAUGHTER, J. W. *The Adolescent.* (Introd. by J. J. Findlay.) New York: Macmillan, 1915. Pp. xv + 100.

LEONARD, W. E. *Socrates: Master of Life.* Chicago: Open Court, 1915. Pp. vii + 118.

SMITH, S. *Who is Insane?* New York: Macmillan, 1916. Pp. 285.

MARTIN, M. E. *The Transfer Effects of Practice in Cancellation Tests.* New York: Science Press, 1915. Pp. vi + 68. (Arch. of Psychol., No. 32.)

STENQUIST, J. L., THORNDIKE, E. L. & TRABUE, M. R. *The Intellectual Status of Children Who are Public Charges.* New York: Science Press, 1915. Pp. iii + 52. (Arch. of Psychol., No. 33.)

[2] Briefly reported in *Amer. J. of Insan.*, 1913, **69**, 897–906.

NOTES AND NEWS

At the request of the department, the department of philosophy at Smith College will hereafter be officially designated the department of philosophy and psychology. Dr. John T. Metcalf, instructor in psychology at Princeton, has been appointed instructor in psychology. Miss Ruth Swan Clark, assistant in psychology, has been granted a year's leave of absence.

The informal meeting of experimental psychologists will take place at Princeton, April 20–22.

An invitation has been received to attend the meeting of alienists and neurologists to be held under the auspices of the Chicago Medical Society, June 19 to 23, at La Salle Hotel, Chicago. Much attention will be directed to the problems of feeblemindedness. The circular of information says: "There has been no branch of medicine so neglected as the study of mental diseases and psychology. There should be a great reform in this respect within the near future."

The following items have been taken from the press:

Professor Ivan Pavlov, of the University of Petrograd, has died at the age of 67 years.

Dr. A. Alzheimer, professor at Breslau and one of the editors of the *Zeitschrift für die Gesammte Neurologie und Psychiatrie*, has died at the age of 52 years.

Dr. John W. Todd, of the University of North Dakota, has been given a leave of absence to act as head of the department of psychology at the University of Indiana. Professor John Winter, of Goschen College, takes Dr. Todd's work at North Dakota.

Leave of absence has been granted for the winter semester to Professor Ruger of Teachers College.